ORIGINAL ARTICLES

Scientific and General

NEW PROBLEMS IN THE FIELD OF THE INDUSTRIAL TOXICOLOGIST*

ALICE HAMILTON, M. D.
Boston, Massachusetts

I ALWAYS feel apologetic when I face a general medical audience because my specialty is such a small and relatively insignificant one.

Even industrial medicine is only one of the lesser specialties, and when I cover only a part of that, industrial toxicology, we get down to a very small specialty indeed. It is, however, very gratifying to me to find that the California Medical Society considers it important enough to devote time in their First General Session to a discussion of the newer problems of industrial toxicology.

In speaking of them I want to include also older problems which have been with us a long time, but which have increased in importance with the war. To begin with there is that very important feature of industrial poisoning which cannot be emphasized too often and whose importance has increased, and that is the factor of clean air, for we must not forget that the great majority of industrial poisons enter the human body by way of the breath, not through unwashed hands, and only to a limited extent through the skin. That does have to be emphasized over and over again.

I am sure you all remember how long we were led astray in the attempt to control lead poisoning by insisting upon men washing their hands before they ate their lunch, scrubbing their nails. I used to feel that I was pursued by a nightmare of scrubbing the nails and never have I been able to understand how the doctor reasoned out that the lead under the man's nails got into his body and poisoned him. But it was nail brushing that was always emphasized back in the days when I first went into industrial medicine. Of course we got away from that. But it took us a long time.

⁊ ⁊ ⁊

I well remember a great smelter-refinery on the Atlantic Coast which, when a compensation law for industrial diseases was passed in the State of New Jersey, was faced with the problem of doing something about lead poisoning. They consulted a so-called expert who told them to put up a comfort house, with showerbaths, hot and cold water, provision of soap and towels and even of washable uniforms for the men. At the end of the year they had just as much lead poisoning as ever, because, of course, nobody had thought of fumes and dust, and the men were breathing just the same sort of air.

I do think in the control of lead poisoning we have left that position far behind. But not very long ago I read an article by an eminent physician on the prevention of benzol poisoning and he started out with, "Bodily cleanliness is of prime importance in the prevention of benzol poisoning." Well, I should simply have changed that sentence to, "Bodily cleanliness is absolutely of no importance in the prevention of benzol poisoning." A man could not protect himself against breathing benzol fumes no matter how cleanly he was in his habits. It is misleading. It is partly the subconscious comfort that a man gets in being able to pass on to the worker the responsibility for a very distressing occurrence, a case of occupational disease, and to that temptation a good many men do succumb.

⁊ ⁊ ⁊

In the war industries it is increasingly important that the air be kept clean. For one thing, we use heat more than we have ever done before. And heat has a great importance in three ways. In the first place, all of our estimates of what we call the maximum allowable concentration of a poison in the air are based upon an eight-hour day, the amount of air that a man will breathe in during that eight-hour day at an ordinary rate and depth of respiration. But heat increases the depth and the rapidity of respiration. Heat makes a quantitative increase in the amount of poison a man absorbs.

In the second place, heat causes sweating of the skin, helps the solution of the poisonous dust that has fallen on the skin, and this is of enormous importance in those poisons, the derivatives of the coal-tar group, which enter primarily through the skin. That includes TNT and others of our explosive poisons and heat also dissolves the poisonous dust and by flushing the surface vessels hastens the absorption by the skin.

In the third place, heat aids in the volatilization of a volatile poison.

We have increased our hot jobs. We have substituted welding for riveting to a great extent. We use hot degreasing instead of cold degreasing. When I first saw degreasing, the metal parts to be degreased were put in baskets and dipped in great tanks of cold degreaser, usually carbon tetrachloride, then later on trichlorethylene. As you can imagine, as the dipping went on more and more grease got into the tank and diluted the degreaser too much, so that toward the end of the day it was not working well at all. Now they degrease with the fumes, and no matter how much grease is down in the tank, so long as the fumes come off, the fumes do the degreasing. Of course that increases very much the danger of poisoning from these volatile solvents which are none of them non-toxic. All of them are narcotics and some have a very distinct damaging effect upon the organs.

Of the two favorite ones, carbon tetrachloride and trichlorethylene, we always prefer the latter

---

* Guest Speaker's Address. Alice Hamilton, M. D., is Professor Emeritus, of Industrial Medicine, Harvard University Medical School. Given before the First General Meeting, at the Seventy-third Annual Session of the California Medical Association, Los Angeles, May 7-8, 1944.

because although all of the chlorinated hydrocarbons are poisons, the unsaturated, such as trichlorethylene, are much safer. They are strong narcotics, stronger than the saturated, but they do not attack the liver and kidneys. Carbon tetrachloride, which is tetrachlormethane, is a saturated compound (as is chloroform, or trichlormethane).

There is also an increase of youthful workers. I am not going to say anything about the increase in the use of women, that has very well been dealt with by experts who know more than I do because my specialty has had to do predominantly with men's trades. But the increased employment of youthful workers is a serious feature when you consider the poisonous trades. I have been told that we have no statistical proof of the increased danger of poisons to the youthful. Well, I think we have some, not very extensive or impressive, but in the first World War we found a distinct, marked difference in the resistance to TNT poisoning between the men under twenty-one years of age and the men over thirty years of age. It was very striking, so much so that we notified the War Department that they were wasting time in employing young men. Of course, it did not have any effect, but still we did notify them.

The English found, in connection with ether poisoning in the making of smokeless powder, that the young girls were far more susceptible. In connection with trichlorethylene, we do a great deal of experimenting in Connecticut, and anyone who has had experience with it will tell you that a young girl is more likely to pass out than an older woman. Then William Schmidt of the Children's Bureau points out that the immature organism breathes in a greater volume of air per unit of body weight than does the adult, has a greater surface of skin for absorption per unit of body weight and a more rapid circulation, all of which would work to the more rapid taking up of the poison and a more rapid circulation through the body.

If, and I hope it will not come to pass, we have an opportunity to see what the poisons do to the young, we should certainly gather statistics to be able to settle this question. But it has never yet been true in this country that large numbers of young people have been exposed to trade poisons and I do not believe it will be true. That is why it has been so hard for us to get any real information on the subject.

We have never employed young people in the poisonous trades to any extent, and the Children's Bureau has now been given a good deal of authority to forbid the employment of young people under conditions which the Bureau finds dangerous.

* * *

Some of the old and familiar poisons are coming in with new trades or coming back in old trades. I went over a great shipbuilding plant at Fall River, Massachusetts, a few years ago and was very gratified to find they were not using lead paint. They said the navy had given it up and so they gave it up for all of their ships. That seemed to me a great step forward. Then not very long ago I was told that although the navy still, and I believe it is true, does not use lead paint, the Maritime Commission does, and that now the hulls of ships are being sprayed with red lead paint. I do not know how carefully the men who are doing the spray painting are protected, out of doors mind you, with the wind blowing toward them—you could hardly expect the men could get to the windward of the spray all of the time—nor do I know how they can be protected. It would have to be of course personal protection, with an air helmet or a positive pressure mask if the protection is to be adequate. Anyway that danger has come back after we had thought it was quite sidetracked.

* * *

Benzol has come back in rubber manufacture, although I was assured last night by three physicians connected with rubber companies that now it is possible again to get toluols and the large rubber companies have gone back to this much safer solvent. For months after the war began, toluol was needed for TNT. It is not so good a solvent as benzol but they use it because they want to protect their workers.

* * *

Tetrachlorethane has come back. Physicians learned during the last war from a bitter experience, first in Germany, afterwards in England (fortunately we were warned in time) that tetrachlorethane is the most poisonous of all the chlorinated hydrocarbons. (About penta and hexa we know little.) The cases in the British factory inspection reports are listed under toxic jaundice, along with arseniuretted hydrogen cases. And that is the form it takes in the majority of cases, an acute yellow atrophy of the liver, although there is also a form which attacks the marrow of the bones and results in aplastic anemia, and the Germans reported some cases that were purely nervous in character. But in the last war we were, as I say, warned in time; we did not have cases.

The few cases we saw came after the war, when they began making artificial silk as we called it then—cellulose acetate silk—the best solvent for the acetate being tetrachlorethane. One of these factories was near Boston and I saw the first case of jaundice which developed there. The management at once instituted all possible precautions and soon changed to another solvent, and, so far as I know, tetrachlorethane was not used in industry in the years between the two wars to any extent. Now I find it on the lists of the Bureau of Standards and the army and the navy as a very valuable solvent. Well, it is. But if you were thinking of the producer and not the product you would not touch tetrachlorethane.

* * *

There is great increase in the use of halowax, which is a mixture of chlorinated napthalenes. That is a curious situation. Halowax has been used for many years. You know it is a very good insulating material, practically essential for covering electric wires. Here, and in England and on the Continent, it was used for years with no more serious effect on the users than a pustular acneiform eruption. Then suddenly and most mysteriously a few cases of acute yellow atrophy of the liver appeared in Connecticut and Massachusetts in men working with halowax. Fortunately the Industrial Hygiene Bureaus of those two States have very alert men in charge. In former years nobody would have thought of any occupational connection with such cases, because there was nothing in the literature to indicate it.

Correspondence with the European authorities threw no light on the problem, no cases of liver damage had ever been reported, but A. S. Grey of Connecticut and Bowditch of Massachusetts could not escape the belief that their cases were occupational in character. Confirmation came from New York. Leonard Greenburg, of the Bureau of Industrial Hygiene, discovered a number of cases in the following two years, not a large number, but two in one plant and I think four in another, and a far larger number of nonfatal cases, all of acute degeneration of the liver. Autopsies showed typical acute yellow atrophy. It transpired that what had happened was this: Abroad and for many years in this country, the lower chlorinated naphthalenes were used, chiefly trichlornaphthalene. Then, in the desire of our industrial chemists to obtain a faster and better method, they substituted the higher chlorinations, penta and hexa. That is where the trouble came in. The addition of those extra atoms of chlorine shot the danger up as it does every time. The larger the number of chlorine atoms, the greater the danger of injury to the liver. We are increasing the use of halowax very much and the warning is that, whatever form of halowax you use, the solvent must not be another chlorinated hydrocarbon, for that doubles the danger. Nor should any man work with halowax who has ever been exposed to any of the chlorinated hydrocarbons.

A number of new problems have come in that we did not have during the first World War. I think that one of the serious ones is the increased use of cracked petroleum. As you know, cracked petroleum is made by distillation at a heat so great that the molecules do crack up and you have as a result a change in the proportion of paraffins and olefins, and also the production of a certain quantity of aromatic hydrocarbons, the benzol group, which of course brings in a new danger.

In the early years of the century and in the first World War, when one found that a plant was using a solvent that belonged to the petroleum distillates, benzine, petroleum ether, naphtha, or whatever you called it, one felt that it was pretty safe. It was really the most harmless of the solvents used. Now you cannot feel safe with a petroleum distillate. My attention was called to this years ago, first by an article by Dr. J. Martin Askey of Los Angeles who ran down a case of aplastic anemia which apparently resulted from exposure to gasoline fumes. That was unbelievable but he found that the gasoline the man was using had a high proportion of benzol in it. Now since the cracking process, we have come to look for that in all places where the peteroleum distillates are used.

If you have a case of serious and unexpected symptoms in a worker in gasoline—and we do not expect anything more than a functional neurosis in such a worker—if there is real organic change, especially if it affects the blood picture, then our reasoning is that you have to do with coal tar benzol.

You do not have to look out for nitrous fume poisoning as much as we do in the Eastern plants where the explosives are produced. That was our great danger in the first World War because the production and the use of nitric acid were quite new in American industry, and engineers had not yet succeeded in coping with the situation. You know nitric acid eats through practically everything and it was always eating through pipes and machines resulting in sudden explosion and the pouring out of those angry yellow, deep orange fumes, and the men fleeing before them. And then some of them always breathed in enough of the fumes to give real trouble. But that danger has been dealt with by the engineers and we have very little nitrous fume poisoning in TNT and other explosives production.

How much there is in connection with welding we shall not know for some time. Very exhaustive studies, as you know, involving a very large number of welders, are going on in many plants with regard to what actually happens in welding. We started out thinking that the danger of nitrous fume poisoning was very great and I am afraid we are beginning to think that it is even slighter than it is. I do not know.

I heard a discussion on that very subject by Dr. Carey McCord, not long ago in New York and it seemed really that there was very little evidence of serious danger from nitrous fume poisoning in that work. But there are other dangerous fumes in welding at times. There is the possibility of manganese poisoning which to my mind is about the most distressing of the industrial poisons, because it is absolutely incurable, and so distressing in its effects. We are using much of it in steel and we are welding a great deal of the steel. Now we are beginning to have cases drifting in of manganese poisoning in welders.

Hydrofluoric acid and the fluorides have come into sudden prominence such as they never used to have. Hydrofluoric acid is, I think, dreaded by anyone who has ever had anything to do with its use. I used to be consultant to the General Electric Company and would go around to all of the Mazda Lamp Works where the frosted bulbs were produced, the frosting being done with a dilute solution of hydrochloric acid. I can assure you they used excessive precautions in that department. They were very much afraid of the burns on skin or in the eye. The next place I found it was in a factory making enameled sanitary wear, of the cheaper kind, enameled ironware. And there, instead of sand-blasting a defective coating to be able to put on a new one, they were dipping the ware in hydrofluoric acid, a use for this acid which I had never seen before. There, too, they were very apprehensive of both fumes and droplets. You know the slightest splash does cause such a very bad burn. I find hydrofluoric acid has a new use now as a catalyst in the production of light octane aviation fluid, and that the way it is used requires scrupulous care if trouble is to be avoided.

The fluorides also have suddenly become very important. Up to recently we knew of fluoride poisoning only from French descriptions, the "cachexia fluorica" of French cryolite miners. Cryolite is the double fluoride of aluminum and sodium. The French described a thickening and opacity, in x-ray pictures, of the bones, with exostoses and with calcification of ligamentous attachments, accompanied by the cachexia of anemia, loss of weight and gradual loss of strength. Then the Russians wrote about it and the Swedes, all of them in connection with cryolite mining.

We are just beginning to turn our attention to it in this country. Fluorides are very important, I believe, in the making of certain kinds of steel. The American cases that I have been able to find in the literature are very few. Wilton Kerr reported an autopsy on a man in whom the x-rays had shown dense shadows of the bones, and calcification of the ligamentous attachments: at autopsy the bones were found to be very thick and heavy, with wide, plate-like exostoses and a great excess of fluorine in the bones. The man had worked eighteen years in finely ground phosphate dust containing only 3.8 per cent fluorine but he had been at it a long time.

There is exposure to fluoride in magnesium foundries, where it seems to be used as an inhibitor, and the danger comes in the dusty jobs, the shake-out and the chipping. We have no data to indicate at what point the danger begins. We all know that a dilution of fluoride in the drinking water above a certain point produces mottled teeth but below that point the presence of fluorine in the drinking water is supposed to be actually beneficial. At what point it begins to be injurious to a greater extent than the production of just mottled teeth, which does not really matter much, we do not know. Hodges and his colleagues found in 1938 that mottled teeth were prevalent in a locality where there was a daily intake of water carrying 2.6 milligrams of fluorine, but they found no demonstrable effect on the bones. Even a man who had lived there and drunk that water for 68 years showed nothing. We need very much accurate data on the changes in the bones in all regions where fluorine is present in the water to an extent great enough to cause mottled teeth. Because we do not know now what the danger limit is.

Another of the poisons of which we knew apparently very little, and which has become very important, is cadmium. When one of my students at Harvard wrote a paper on cadmium, it was, I believe, in 1934, he was obliged to go altogether to foreign sources for his information. We had had no experience with cadmium poisoning. Dr. Prodan made experiments on animals and found that the effect of cadmium fumes is primarily upon the lungs, and that it is productive of very severe lung lesions. We are beginning to discover cases in this country. Not only in smelting ores containing cadmium, but in making alloys and in welding alloys, and in cutting cadmium-plated metal with oxyacetylene flame; in electro-plating. So far no cases have appeared in the paint industry, but the danger must be present in the making and spraying of cadmium yellow and cadmium orange paint. Cases of recognized poisoning are very rare but of course we all know that that does not mean that they are actually rare. A case of acute, severe and rapidly fatal pneumonia in a workman in a foundry might not lead the physician to expect any connection with cadmium fumes.

The most recent cases came from the Public Health Service. Thus, Nasatir reported a death which occurred on the fifth day after exposure to the fumes caused by an acetylene flame, playing on cadmium-containing metal. Then the Ohio Bureau of Occupational Hygiene of the Health Department reports two non-fatal cases. The Indiana Bureau of Occupational Hygiene reports two cases, one fatal, in men using a blow torch on cadmium-plated steel pipe. In 1938 Rothwell and Frankish reported fifteen cases with two deaths. Dr. R. T. Johnstone of Los Angeles has a very interesting detailed description in his book of a case of fatal cadmium poisoning in a man using an acetylene torch on the inside wall of a rotary furnace in which cadmium residues had been worked up. The action shown in man as in experimental animals is chiefly on the lungs, the other effects are apparently unimportant. It resembles metal fume fever in its early symptoms; it resembles nitrous fume poisoning in the later stage, with acute congestion and edema of the lungs followed by death, or, if the case is less severe, by pneumonia.

Magnesium fumes, we know cause metal fume fever. But we are only now beginning to hear about occupational gas gangrene from magnesium. Dr. McCord has seen many cases of gas blisters in magnesium workers who get a bit of the metal under the skin. Analysis of the gas showed nothing worse than the constituents of the air, nitrogen, H^2 and O^2, but the lesions are often pretty serious. Apparently the presence of the particle of metallic magnesium under the skin causes the formation of these gases with blisters more or less severe which may or may not go on to ulceration or gangrene. They have had the same experience in English factories. Physicians who have seen these cases advise very strongly a careful removal of all the particles of metallic magnesium which may get into a scratch or cut. McCord produced typical lesions experimentally in animals with metallic magnesium.

A quite new poison (and we do not yet know if it really is one), is beryllium. Beryllium seems to be a very valuable constituent of one of the steel alloys. The Russians have been writing about beryllium poisons for some time. All of our information came from Russian authorities up to very recently. They attribute to the dust of the fluorine compounds of beryllium an irritating action on the skin and on the mucous membranes, and metal fume fever to the fumes in the extraction of beryllium. This last, according to the Russians, is sometimes followed by actual pulmonary inflammation with an x-ray picture resembling acute miliary tuberculosis. However, Fairhall, of the Public Health Service, has made a very exhaustive study of beryllium and says it is not toxic, and the effects noted by the Russians are to be attributed to the fluoride compounds and not to the beryllium itself.

We have a new coating that has come into use and I cannot tell you how much it is used but it is considered a valuable coating for porous building material, stone and plaster and stucco and such. This also has been studied by McCord. It is an organic silicate, tetra-ortho-silicate, a jelly-like compound. McCord finds if you inject it in animals, the lesions, the typical lesions, appear in the lungs and of course still more if the animal breathes a spray. We have no data at all on effects on man.

Then there is the new industry of synthetic rubber which has brought in new problems, although not as many new ones as we expected, because once the rubber has been produced, the solvents are much the same as those for natural rubber. The same groups of compounds, accelarators, plasticizers, anti-oxydants are used so that the really new features that have been brought in are in connection with the production. The first rubber that we made you will remember was neoprene, the oldest variety, made from acetylene and acetylene is of very dubious toxicity. Cases of injury from acetylene poisoning have usually been traced to an impurity because there are some serious possibilities there. Impurities may be phosphoretted hydrogen or arsine, or hydrogen sulphide, but acetylene itself is considered harmless. However, chloroprene, a stage in the production of neoprene, is chlorobutadiene with the toxic action that chlor compounds have, on the liver and on the kidneys. Also it causes hemolysis and a sharp fall in the blood pressure. All of these facts come from study on animals, no such observations have been made on men.

The most important, of course, are the buna rubbers and in connection with these we have three substances to pay attention to, butadiene, momomeric styrene and acrylonitrile. Butadiene has been studied very carefully. It is a gas at ordinary temperatures so it has to be kept under pressure, which means that good engineering will make the premises safe during ordinary procedure, but accidents and repairs will have to be dealt with. One cannot assume that there is no danger at all. So far, all that has been observed in workers is a mild narcotic action. It is possible that there might be enough fumes in the air to cause, not actual intoxication but enough to cause "dopiness"—there is no better word than that—to bring about an accident. However, we have nothing more serious to say about butadiene at present than that it is a mild narcotic. Of course you can kill animals with it but you have to give them a very big dose.

Spencer and Cole of the Dow Chemical Company have made a very careful study of styrene. They find it is acutely dangerous at 24 hundred parts per million, that immediate death in animals is caused by a direct effect on the central nervous system and delayed death by pneumonia. In man all that has been noted has been extreme eye and nose and throat irritation, which comes on when the concentration reaches 1300 parts per million. They advise that the maximum allowable concentration be kept down to 400 parts per million, at which point there is a disagreeable odor that can be easily noted, but there is no danger.

Acrylonitrile is a different thing. It is a cyanide, with the typical cyanide action. It is a poison to the central nervous system and causes changes in the hemoglobin which result in what we call internal strangulation, a sudden, complete anoxemia which may cause rapid death. But there is also a direct effect upon the central nervous system. In man all that has been noted so far are the early symptoms of anoxemia, flushing of the face, rapid breathing, rapid pulse, and also an irritation of eyes and nose which last may serve as a valuable warning symptom. In animals it has been found that sodium nitrite will increase the resistance because it forms methemoglobin which combines with the nitrile molecule and removes it from the blood.

Thiokol, the third form of artificial rubber, is made by condensing polysulfides with a chlorinated hydrocarbon, usually ethylene dichloride. This means the danger of escape of sulphuretted hydrogen, H^2S, the danger inherent in the use of ethylene dichloride.

Those I think are the principal new dangers that have come in the course of the war. I know that many of you had experience through the last war but I do not believe any of you had the peculiar experience that I had which makes me look upon an audience like this with real wonder when I think back to 1917 and 1918. For there had never been a meeting of the American Medical Association to discuss industrial medicine. There had never been, as far as I know, an article on the subject in the *Journal of the A.M.A.*—well, perhaps one—I remember one on lead poisoning but that was about all. Nobody cared about it. Nobody was interested. The Public Health Service had nothing to do with industrial medicine. It was not considered a public concern. During the first World War, a little committee of eminent doctors, among them Richard Pearce and David Edsall, tried to do something about the protection of men in war work but met with no response. Organized Labor was contemptuous about what happened to men who had not sense enough to form a union. The medical profession knew nothing about munition poisons. When you tried to urge prevention on the men of the Army and Navy, they said, "For Heaven's sake, think of our men in the trenches and you talk about fumes!"

So we did not talk about fumes, for nobody would listen. Now, it is so very different that I cannot help hoping for great things. The first war gave industrial medicine a great boost forward. I think the second is going to push it on still further. It is a comfort to think of one good thing coming out of this ghastly mess.

Hadlyme, Conn.

HORMONES AND THE SKIN*

IRVING R. BANCROFT, M. D.
Los Angeles

HORMONES are definite chemical substances which are secreted by certain specialized cells of the body and enter the blood stream, and have a controlling influence on other cells in distant parts of the body. To a certain extent, they are controlled by the autonomic nerve system, and their integrity is dependent on an adequate supply of vitamins. Heredity, however, is the chief factor in their proper function and balance, as well as the chronology of their activity and subsequent necrobiosis.

There are some facts which seem to indicate that the thickness, elasticity, texture, color and blood supply of the skin have some direct relation to the estrogenic and androgenic hormones, and that these are governed by other hormones, especially by the hormones secreted by the pituitary. It is also a fact that certain skin abnormalities are caused by glandular dysfunctions, and that many of these are caused by malfunctions of the autonomic nerve system.

It is a well known fact that the pregnant female of all mammals has an excessive supply of estrogenic hormones, and that the new born from that female also has an over-average supply of female hormones which is derived from the mother, and that, as a consequence, the Wasserman test is identical with that of the mother for the first few weeks. Later it becomes specific for the child. Another change is in the vaginal canal. At birth the vaginal mucous membrane is lined with ten or twelve layers of cells, and within a few weeks this area becomes thinner, and is composed of only two or three layers of cells, and remains at about the same thickness until near the age of eight, when the estrogenic hormones begin to be secreted in larger amounts, and the vaginal mucous membrane becomes thicker and remains at about the same thickness until the menopause. It is during the time when the vaginal mucous is thin that children are susceptible to gonorrhea, and post menopause women are apt to have intractible itching, and both of these conditions are improved by the local application of estrogenic hormones which causes thickening of the vaginal mucous membrane. This correlation between the thickness of the vaginal mucous membrane and the amount of estrogenic hormones is the basis of pregnancy tests by the use of animals.

RELATIONSHIP TO CHANGES IN THE SKIN

Before puberty, the skin of a male and a female child shows little difference in appearance or anatomy. There is, however, a considerable difference in hydrogen ion concentration between a child and an adult. Before puberty, the PH of the skin varies between 6.2 and 6.4. After puberty, it is definitely more acid and the PH is between 4.5 and 5.6. This lowered alkalinity is sufficient to retard or prevent the development of certain tenia infections which are notably prevalent in children, and do not ordinarily occur after puberty. Androgenic or estrogenic hormones are logically and successfully used to cause a higher degree of acidity in the skin, and to thus discourage the growth of those forms of tenia which are prone to attack children only. As the age of puberty approaches, beginning at about eight in a girl and somewhat later in a boy, the secretion of estrogenic and androgenic hormones increases and it is then that the differentiation of the sexes becomes more apparent. Each individual has a mixture of androgenic and estrogenic hormones, being constantly secreted and acting in such a manner as to influence sex characteristics. The proportional amount of these hormones determines which sex predominates as far as the psychological qualities are concerned, and also, to a certain extent, whether the skin is characteristically that of a male or female. Between the very feminine woman and the very masculine man, there is a no man's land, where the anatomical and psychological characteristics are not parallel. This is proved by animal experimentation. In birds, the male has a conspicuous coloring, but these may be modified or reversed by castration or injecting appropriate hormones. If the ovary of a young bird is removed, brilliant plumage and capon characteristics develop.

* Chairman's Address. Read before the Section on Dermatology and Syphilology at the seventy-third annual session of the California Medical Association, Los Angeles, May 7-8, 1944.